A real-time spatio-temporal data exploration tool for marine research

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A thesis submitted in partial fulfillment of the requirements for a Masters Degree at the School of Geography and Environmental Studies, Faculty of Science, Technology and Engineering, University of Tasmania (October 2009)

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed

Tony Veness
16th October 2009.

ABSTRACT

The resources required to acquire high quality scientific data in a marine environment can be great. The complication of acquiring data from a platform which pitches, rolls and heaves makes the challenge even greater. The variability of the weather and sea conditions, along with equipment failures, seemingly conspire against the marine scientist. There is a great need for good quality-control measures, accurate electronic record keeping, and effective voyage management at sea if a good outcome from an expensive sea voyage is to be expected.

Typically, the plethora of navigation, data acquisition, quality control, Geographical Information Systems and databases used at sea on the world's research vessels do not allow an intuitive, holistic, spatial and temporal view of real-time data. "How close are we to the ship track from our last visit to the region?" or "What was the deployment depth of the instrument when we were last at this site two years ago?" are typical questions asked by those undertaking research far from shore. Answering these questions like these, in a timely manner, using systems commonly used on research vessels can be difficult.

This study explored the combination of an open-source spatio-temporal DataBase Management System (DBMS) and Keyhole Markup Language (KML), creating a framework for the storage and exploration of real-time spatio-temporal data at sea. The framework supported multiple concurrent users using Virtual Globe browsers. This study created a methodology, which resulted in a functional software tool, *MARVIN*, using open-source software.

Empirical and modelled datasets were used in conjunction with MARVIN, both at sea and in the laboratory. MARVIN was found to be able to provide a simple and intuitive 4D (3D + time) real-time view of spatio-temporal datasets, as they were collected at sea.

The key combination of a spatio-temporal DBMS and KML, offered a robust solution for the storage of real-time data, undertaking of Geographical Information System (GIS) operations, and streaming of data to multiple clients, running Virtual Globe browsers such as Google Earth. The techniques implemented also support existing navigation, GIS, and numeric modelling software commonly used on modern research vessels.

Acknowledgments

I would like to thank my supervisor, Dr Arko Lucieer for his valued support and guidance throughout the coursework and thesis components of my studies. Arko's enthusiasm for research and professional approach sets an example which I and others can only hope to follow.

Dr Jon Osborn provided me with invaluable advice during my four years of part-time study at the Centre for Spatial Information Science, University of Tasmania. Jon's keen eye and sound advice ensured I completed what I needed to complete, when I needed to complete it.

To my partner Jane, whose ability with a red pen is not to be taken lightly, I give many many thanks and promise not to start a PhD, really..…

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